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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Economics

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SOME INTERRELATIONSHIPS BETWEEN THE SUPPLY, PRICE AND CONSUMPTION OF COTTON

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During the past few years price analysts in the Bureau of Agricultural Economics have been engaged in studying the behaviour of prices of the major agricultural products. These studies are a part of the Bureau's endeavor to throw light on the economic problems of American agriculture, to supply farmers with adequate bases for planning their year's output with due regard to consumers' requirements and for planning their seasonal marketings with due regard to market conditions. The application of sound economic principles to these price problems, together with a proper statistical analysis of available facts, has unraveled some of the seeming mysteries of the behaviour of agricultural prices and has revealed certain relationships between supply, price and demand which are of practical import to farmers. The purpose of this paper is to present only a few of the results of these studies in relation to cotton, particularly to the interrelationships between supply, price, and consumption of cotton.

I. Factors Affecting the Price of Cotton.

Before presenting these interrelationships, I wish to demonstrate without going into technical details, the fact that it is possible so to analyze the price of cotton as to determine what are the major factors and their relative importance in cotton price movements. Starting with the general economic principle that price is the result of the interaction between factors of supply and factors of demand, certain series of data were selected representing supply and demand forces, and their relations to monthly cotton prices over a period of twenty years were studied. Among these series, two represent the supply of American cotton, one of these two being the current actual supply, the other the official estimates of the prospective crop or the potential supply. Two series represented the amount of cotton that had gone into American consumption and into foreign consumption through exports. Two other series represented changes in the current and prospective domestic business situation, as indicative of industrial demand for cotton and the buying power of consumers. Another series represented the growth in population and the expanding uses for cotton during the past twenty years. By the process of multiple correla-

tion the average effect of a change in any one of these series on the price of cotton was then determined.

With the average influence of each of these factors on the price of cotton determined, the next step was to reconstruct the monthly price of spot cotton at New Orleans from 1905 to 1926 from these eight factors, on the assumption that if these are the important price determining elements, their composite influence should result in prices not far different from the prices that actually prevailed. The results of this experiment are shown in Chart I. The prices that actually prevailed from month to month from 1905 through 1926 are shown in the solid line. The prices estimated or reconstructed from the eight factors of supply and demand are shown in the dotted line. The closeness with which the estimated or computed prices agree with the actual demonstrates (1) that the factors selected are those which usually operate to establish the price of cotton, explaining about 90 per cent of the total variations during the test period, (2) that the price of cotton is, as is generally known, not made by chance, but by basic forces of supply and demand and (3) that whenever the actual prices are out of line with those usually justified by supply and demand conditions, that is, are either too high or too low, they are very soon adjusted to the proper level. We conclude from this systematic price analysis that the price of cotton during the past twenty years of great changes in domestic and foreign economic conditions has responded in the main to fundamental conditions of supply and demand and that it will undoubtedly continue to do so in the future.

Those of you who are interested in the details of this study and in the statistical methods used, I would refer to a recent bulletin of the Department of Agriculture, entitled "Factors Affecting the Price of Cotton," of which Mr. B. B. Smith is the author.

Our findings from this and subsequent studies as to the relationship between the supply of cotton and price may be divided into two groups, (1) those which show that supply affects price and (2) those which show that price affects supply. Let us take up first the influence of supply on price by considering supply as a factor in the average price for an entire cotton season, and as a factor in the movement of prices during the course of a season.

II. The Effect of Supply on Price.

The size of the American crop and the world carryover of American cotton, together with the general commodity or business situation, and an annual growth in the demand due to the increase in population and increasing uses of cotton, these we have found are the dominant factors in the yearly average price of cotton from August to July. Of these the most important single factor is the total supply for the season, that is, the carryover plus the new crop. During the past eight years these three factors have explained almost perfectly the yearly average of cotton prices at New Orleans. Let me illustrate the basis for this conclusion.

In Chart II the yearly averages of prices at New Orleans are shown from 1920 to date. These prices have been adjusted to a constant general commodity price level. Thus in 1920-21 prices averaged 13.24 cents, in 1923-24, 19.68 cents, and in 1926-27, 14.74 cents. The bars in this chart show the total world supply of American cotton, the black portion representing the size of the crop and the shaded section the size of the world carryover of American cotton. You will note that in general the larger the total supply, the lower the price, and the smaller the supply, the higher the price. You will note also that a small crop does not necessarily result in a higher average price or a larger crop in a lower average price, for a larger or smaller carryover may offset the effect of the change in the crop. Thus in 1922-23, a year of an increase in the crop, prices averaged higher than in the preceding year because carryover had been reduced, making the total supply less than in the preceding year, again, this season with a reduced crop of less than 13 million bales, prices have averaged considerably less than in 1924-25, a year of a somewhat larger crop, because of the depressing effect of an increased carryover at the beginning of this season.

The generalized relationship between the total supply and the average price is shown in Chart III in the form of a supply-price curve. This curve represents the average prices that different supplies would have established had there been no changes in demand or business conditions. On the average, given a world supply of American cotton of twenty million bales, an increase or decrease of one million bales in this supply has caused a decrease or increase respectively of about a cent and a half in price. The additional changes in price due to growth in demand during this period are also shown in this chart. A growing demand for cotton during this period due to increased population, wider utilization, and a recovery from post-war conditions of under consumption is indicated in the upward slanting curve in the third section of this chart. It shows, for example, that had the 1926 supply been of the same size as that of 1925, it would have brought nearly a cent a pound more than in 1925.

In the lower section of this chart we have a demonstration of the fact that the total supply of cotton and this yearly increase in demand have almost completely determined the yearly level of cotton prices, for these dotted lines, representing prices as computed or estimated from these factors, can hardly be distinguished from the solid line which represents the actual prices that prevailed during each of the past eight seasons.

In this fact that the total supply for the year, with demand conditions unchanged, determines the level of prices for the year there is considerable practical significance to producers. In the first place, it has a very definite bearing on their plans early in the spring as to what acreage to devote to cotton. At that time the individual farmer needs to make an intelligent guess as to the probable price that he may realize for his crop when it is ready for market. On the basis of that estimate he may more intelligently determine how much of his efforts to put into cotton and how much to devote to other products. Our study of the factors influencing the yearly price that may be expected to prevail during a season, suggests that farmers need to take into account, on the side of supply, the probable total crop and the world carryover of American cotton. How farmers may take these factors into account will be indicated presently in discussing the influence of price on supply, for it will be

shown that price is an important element in the prospective carryover, acreage, and yield which together constitute the next season's total supply.

This relationship between total supply and yearly average price has also a very definite bearing on the farmers' marketing policies after the crop is produced. It can be used by them as a very important guide, together with other considerations, in determining whether the crop can be more advantageously marketed early in the season or later. If prices during the first part of the season are higher than the average indicated for the entire season by the fundamental factors of supply and demand, they may normally be expected to decline, in which case the crop could be more advantageously disposed of early. But if prices early in the season are lower than the probable average for the year, they are likely to advance. In this case, the crop could be more advantageously marketed later in the season.

The influence of supply on the movement of prices from month to month during the cotton season calls for a distinction between the actual supply available each month and the potential supply as indicated by estimates of the prospective crop during the summer and fall months. The effect of a given current actual supply is not the same for each month of the year. Thus, a domestic supply of five million bales in July, which is large for that time of year, tends to depress prices, while a similar supply in December or January, small for that time of year, tends to raise prices. In the case of the potential supply, a given estimate early in the season has a smaller effect on prices than in the later months when the estimates are better approximations to the final outturn of the crop. The details of these quantitative relationships and their changes from month to month are given in the bulletin already referred to.

In applying these facts as to the shifting influences of actual and potential supply on price to the problem of marketing early or late in the season, it is, of course, necessary to establish early in the season a generalized relationship between the size of the crop and the probable seasonal price trend. Such a generalization is presented in Chart IV. Here the average seasonal changes in prices from August through July are shown for years of large crops and for years of small crops. In the case of years of large crops, prices usually decline during the first half of the season below the yearly average, and then turn upward on the expectation that the next crop would be smaller, and if such are the indications during February and March, they continue to rise to the end of the season, but if in the spring the prospects are for another large crop, prices turn downward for the remainder of the season. In the case of years of small crops, prices start below the yearly average during the first few months of the season and reach a peak in December and January with a decline thereafter if the prospects are for a larger crop the next year, but continue to advance if prospects are for another small crop.

III. The Effect of Price on Supply.

The second group of interrlationships between supply and price, where price influences succeeding supply, has already been touched on by Mr. Callander when he referred to the effect of price and fertilizer on acreage in the next crop. If prices received for a crop are unsatisfactory to producers and if they continue so up to planting time, acreage is usually reduced, and if they have been satisfactory, acreage is usually increased. Whether or not prices are satisfactory depends among other things upon the prices of other commodities that might be produced instead of cotton. The price received for a given crop also influences the next year's supply by acting as an indirect influence on yield. We have found that the amount of money spent for fertilizer in the Cotton States is very largely determined by the income derived from the preceding crop. As a rule, about 10 per cent of the income from the cotton crop is spent for fertilizer in the Cotton States the following year. The price in one season thus influences the supply of the next season by creating changes in acreage and by creating changes in yield through the application of fertilizer.

Still another influence of price on the next year's supply is to be found in the relation of price to carryover. High prices during a crop season have in the past been followed by a reduction in the world carryover, and low prices have been followed at the end of the season by an increase in carryover. A reduction in carryover may be in part the result of a short crop, and an accumulation may be due in part to a large crop, but a large crop and low prices encourage holding for investment or as an insurance against a short crop the next year, and a small crop and high prices have the opposite effect. Price is therefore very definitely a factor in determining the carryover and the next season's total supply. During the past eight years the average price of cotton at New Orleans during the season has been a remarkably good indicator of the total world carryover of American cotton. This fact is shown in Chart V.

IV. The Effect of Consumption on Price.

The major relationships between consumption and price may also be treated from two angles, first, the effect of consumption on price, and second, the effect of price on consumption, for our studies indicate that the influence works both ways. It should perhaps be made clear at the outset of this discussion on consumption that the only data available for analysis relate to the consumption of cotton by mills. Indications of the volume of consumption or purchases of cotton and cotton goods by wholesalers, retailers and ultimate consumers are not available. Our remarks, therefore, refer only to the relation between mill consumption of American cotton and price.

We find, first, that the amount of cotton which has gone into the channels of consumption has a very definite relationship to the current level of cotton prices. A large volume of cotton consumed by mills in the recent past acts as a depressing factor and a small volume as a stimulating factor on price. Stated in another way, when the channels of consumption from the mills back to the retail stores are or have been well supplied with cotton and cotton goods, the current demand is naturally not so keen as when they are or have been inadequately supplied. This

relationship also holds for the foreign consumption of American cotton.

V. The Effect of Price on Consumption.

The nature of the influence of price on consumption can readily be shown by observing the world consumption of American cotton and the price of cotton at New Orleans during the past five years. In 1922-23 when adjusted prices averaged about 24 cents, the world consumption of American cotton was approximately 13 million bales. In 1923-24 prices averaged above 30 cents and consumption fell off to nearly 11 million bales and in 1926-27 when prices averaged less than 15 cents, world consumption of American cotton increased to nearly 16 million bales. Thus, during the past five years, an increase or decrease of about 3 cents in the yearly price produced respectively a decrease or increase of about one million bales in world consumption.

A final illustration of the effect of prices on consumption is found in studying the factors which influence cotton mill activity in the United States. During the past ten years, cotton mill activity appears to have been determined by two dominant factors, namely, the general condition of business activity in the United States and the price of cotton. Cotton mill activity has shared in the fluctuations of general manufacturing activity, being affected by the business depressions of 1920 and 1924, as well as by the active business conditions of 1923 and 1925. To observe the effect of the second or price factor on the consumption of cotton by mills, it is necessary to eliminate the influence of business activity from our data. This has been done in the comparison shown in Chart VI.

The upper line represents the monthly price of spot cotton at New Orleans from January, 1919, to March, 1928, adjusted for changes in the general level of commodity prices. The lower line shows the index of cotton mill consumption for the same period, adjusted for changes in general business activity and growth in industrial output as reflected in the Federal Reserve Board Index of production of manufactures. This adjustment gives us a measure of the changes in mill activity which are not due to fluctuations in the business cycle, to changes in the growing industrial demand for cotton or to changes in the buying power of consumers. In other words, this comparison shows approximately the real relationship between price and mill consumption of cotton, and inasmuch as mill consumption rests on mill purchases, we have here the influence of price alone on the amount of cotton purchased by mills.

There are two outstanding facts in this relationship: (1) relatively high prices presumably reduce the volume of mill purchases and are consequently followed by a reduction in the relative volume of cotton mill activity or consumption. Low prices presumably stimulate purchases and are consequently followed by an expansion in mill activity or consumption; and (2) the high prices precede the low volume of production and the low prices precede the peaks in consumption of a period of approximately six to eight months.

The practical significance of these relationships is that they indicate that the mill demand for cotton conforms to economic law, and that they suggest that the volume of mill activity during the course of

a year or during the course of six months, as affected by price, can be forecasted at least six months in advance. In Chart VII the possibility of such a forecast is illustrated by means of a simplified application of multiple curvilinear correlation to the data on cotton mill consumption for the calendar years from 1919 through 1927. Without discussing details, it will be observed that Section I of this chart shows the generalized relationship between the average price during a crop year and the adjusted volume of mill consumption during the following calendar year, indicating that high prices are followed by a reduction, and low prices by an advance, in consumption. The second section of the chart, derived from the first, shows that during this period there has been a gradual downward trend in the relative consumption of cotton by American mills. It shows that although the total volume of consumption has increased during this period, the increase has not been as rapid as the industrial growth of the country, and that mills do not consume now as much cotton at a given price as they did in the earlier part of this period.

The third section shows the growth and variations in general manufacturing output in the United States annually from 1919 to date. This index is at the same time a measure of the industrial demand for cotton and at times of changes in the volume of industrial employment, an important factor in the buying power of consumers. In the fourth section is demonstrated the fact that these three factors, namely, the general business situation, the price of cotton in the preceding months and the downward trend in the relationship between price and consumption explain very satisfactorily the volume of cotton consumed during the course of the year. The dotted line represents, as before, the index of consumption estimated from these three factors and the solid line shows the index of actual consumption. A similarly close estimate can be secured for six-month instead of twelve-month periods by relating the prices of one six-month period to the consumption of the following six months.

VI. Conclusion

The chief conclusions of my remarks may be restated briefly as follows:

Supply affects price: The total supply (crop and carryover) which is usually known at the beginning of the season very largely determines the average level of prices for the year. The size of the crop and the probabilities as to the size of the following crop determines the major monthly movements during the course of the crop season.

Price affects supply: It is a very important element in the following year's acreage. It influences yield in the following year through the amount of fertilizer bought by farmers and it affects the rate of consumption and the amount of the world carryover at the end of the season.

Consumption affects price: Large volumes of cotton and cotton goods in channels of consumption secured at low prices act as a depressing factor, and low volumes as a stimulating factor on subsequent cotton prices.

Price affects consumption: Low prices during the course of a season result in increased mill purchases and in a higher domestic and world mill consumption of cotton. High prices have the reverse effect. In the United States low prices during a given period of six months are followed by increased mill consumption of cotton and high prices are followed by a reduction during the following six months.

These interrelationships are important to cotton producers: They need to be taken into account before finally determining what acreage to devote to cotton in a given year, and when the crop is once produced, what marketing policy to follow in order to dispose of the crop most profitably.

MIDDLING SPOT COTTON PRICE, NEW ORLEANS, AND PRICE ESTIMATED FROM VARIOUS FACTORS

Monthly, June 1905 to Date *(YEARS BEGINNING IN JUNE)*

CENTS PER POUND
40
30
20
10
0
Estimate
Actual
J. O. F. J.
1905 '06 '07 '08 '09 1910 '11 '12 '13 '14 1915 '16 '17 '18 '19 1920 '21 '22 '23 '24 1925 '26 '27

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3

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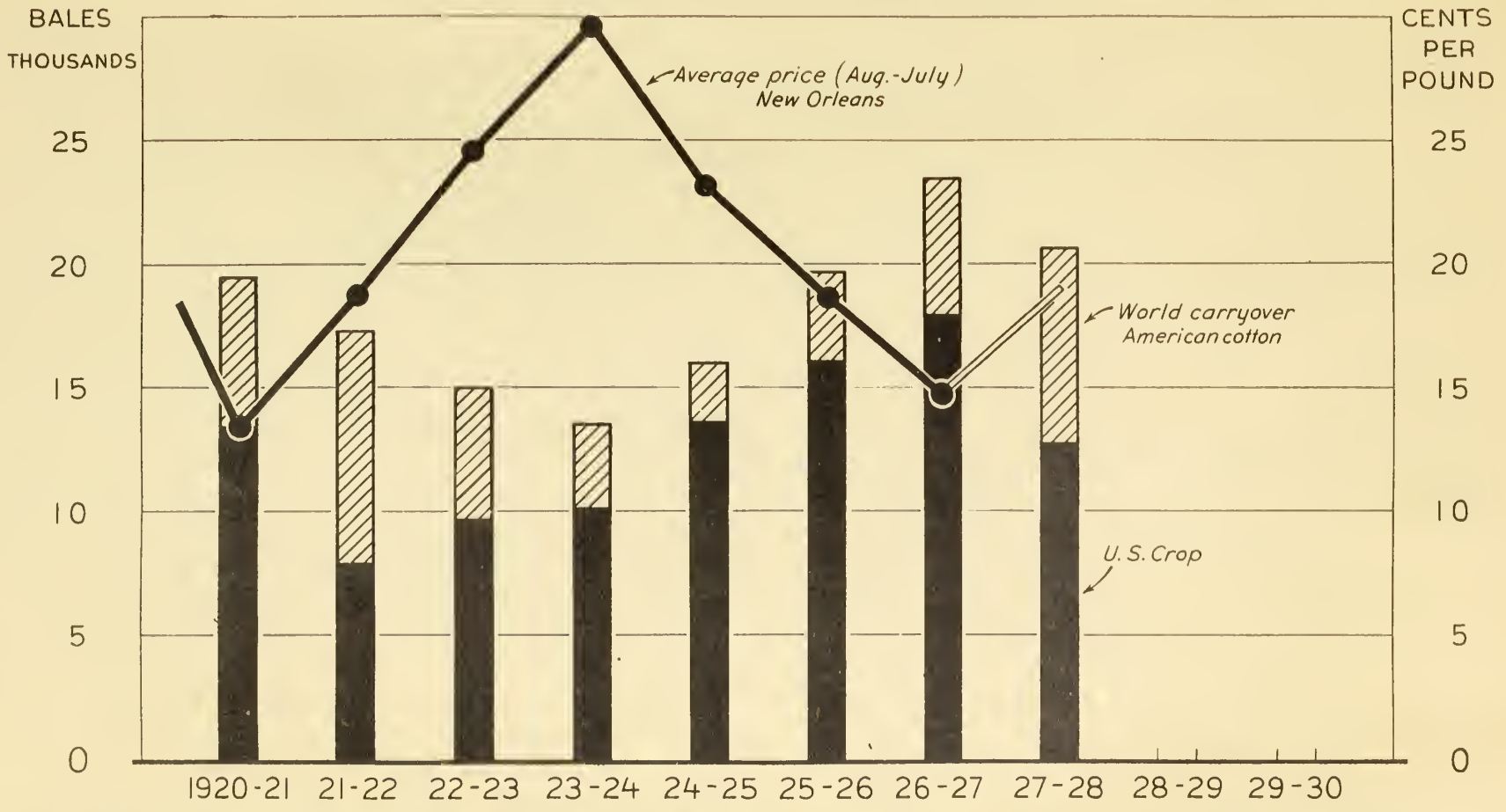
RELATION BETWEEN TOTAL SUPPLY OF AMERICAN COTTON (U.S. CROP AND WORLD CARRYOVER) AND AVERAGE PRICES OF SPOT COTTON AT NEW ORLEANS, 1920-27



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6

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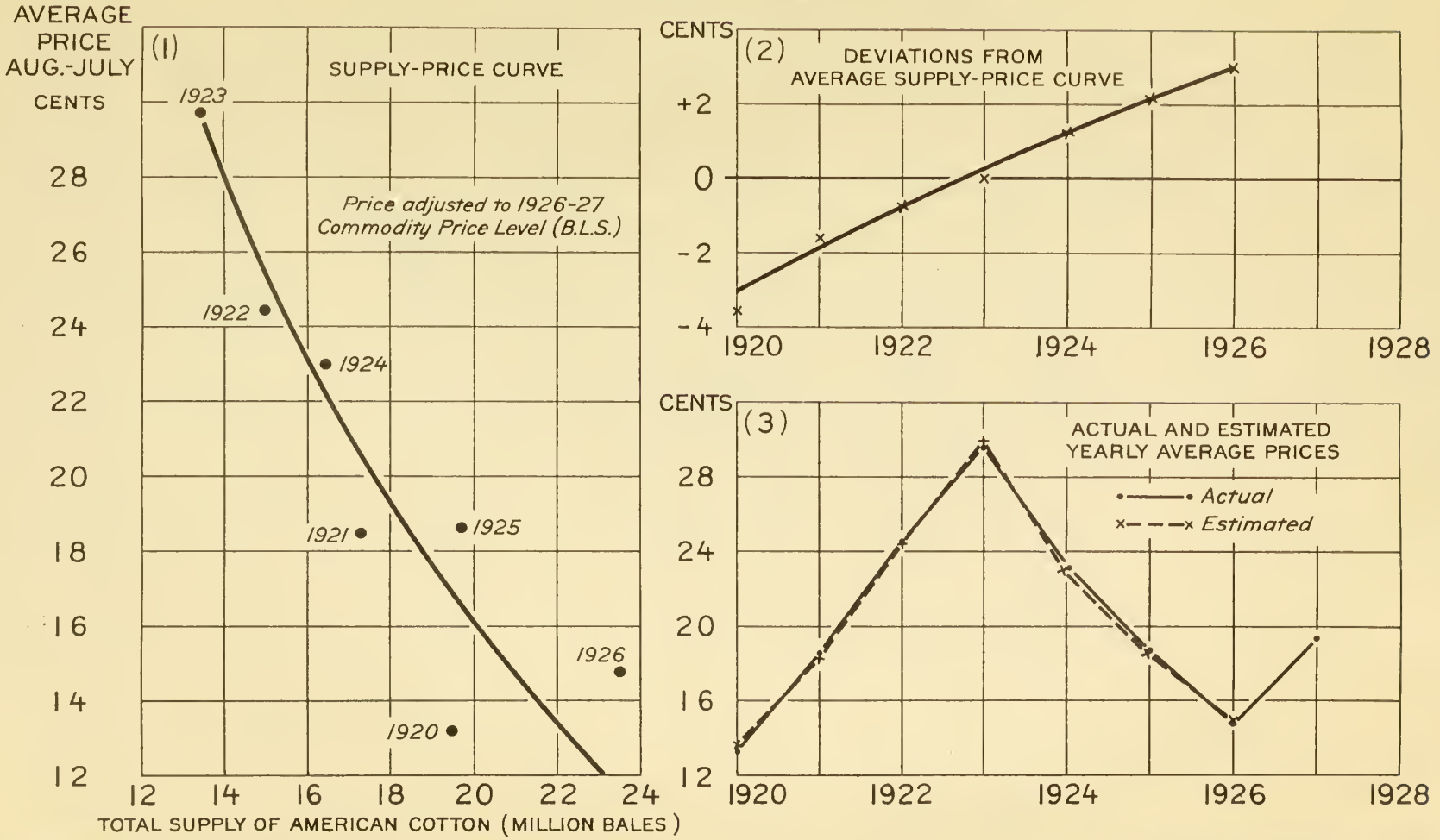
FACTORS AFFECTING THE YEARLY AVERAGE PRICE OF SPOT COTTON AT NEW ORLEANS



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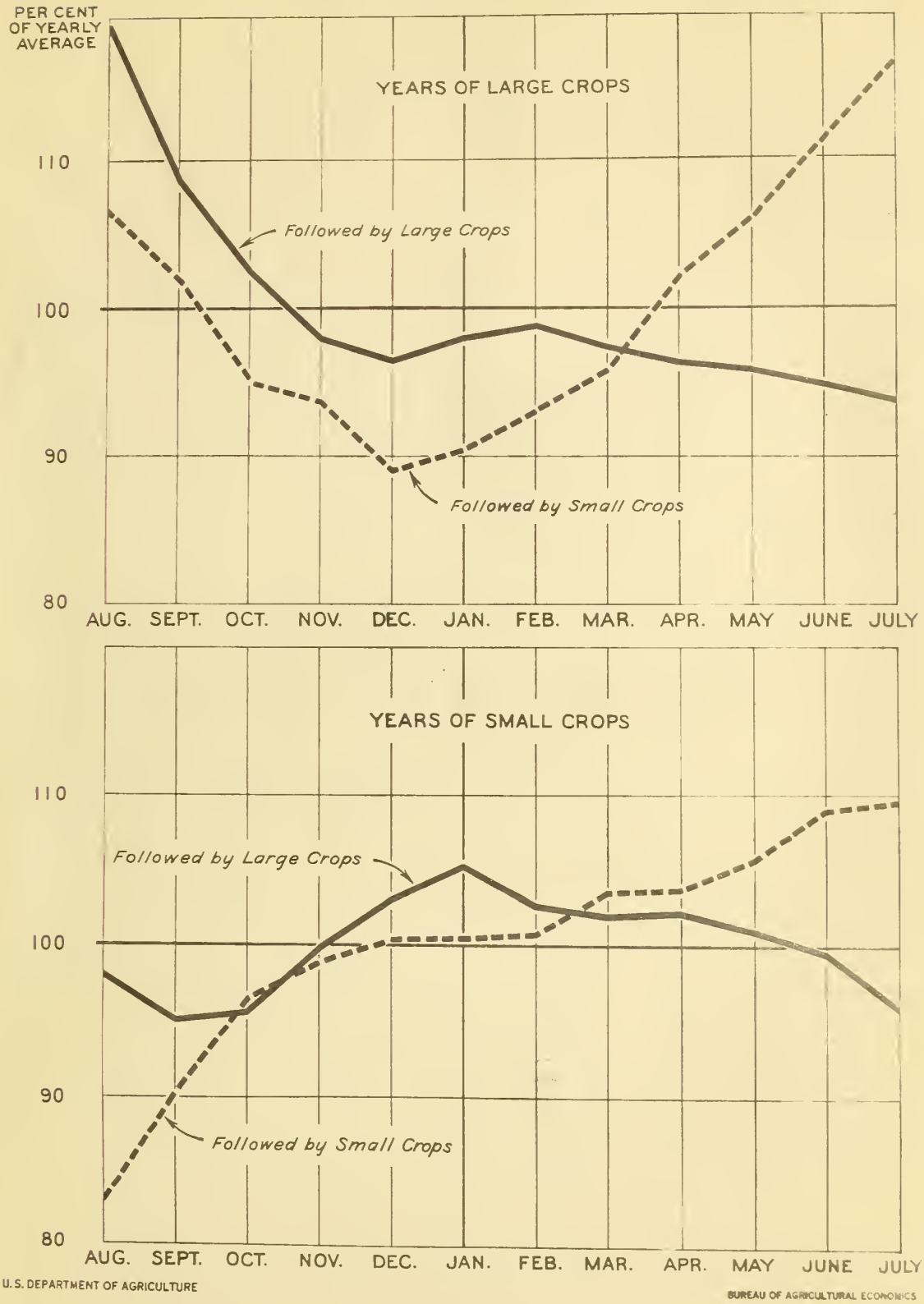
CHANGES IN COTTON PRICES IN YEARS OF LARGE AND SMALL CROPS



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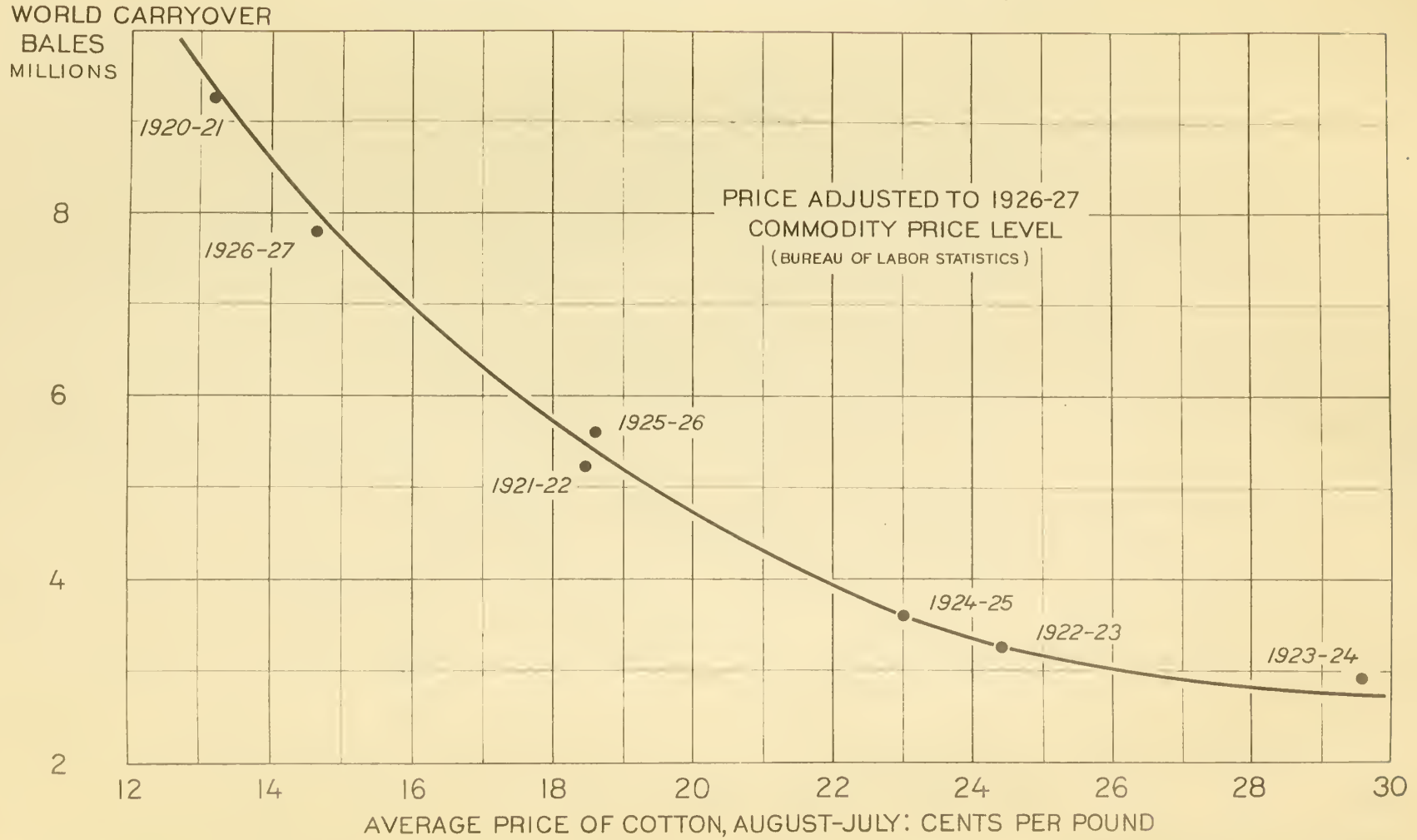
IV

Relation Between Average Yearly Price of Cotton at New Orleans and World Carryover of American Cotton at End of Season



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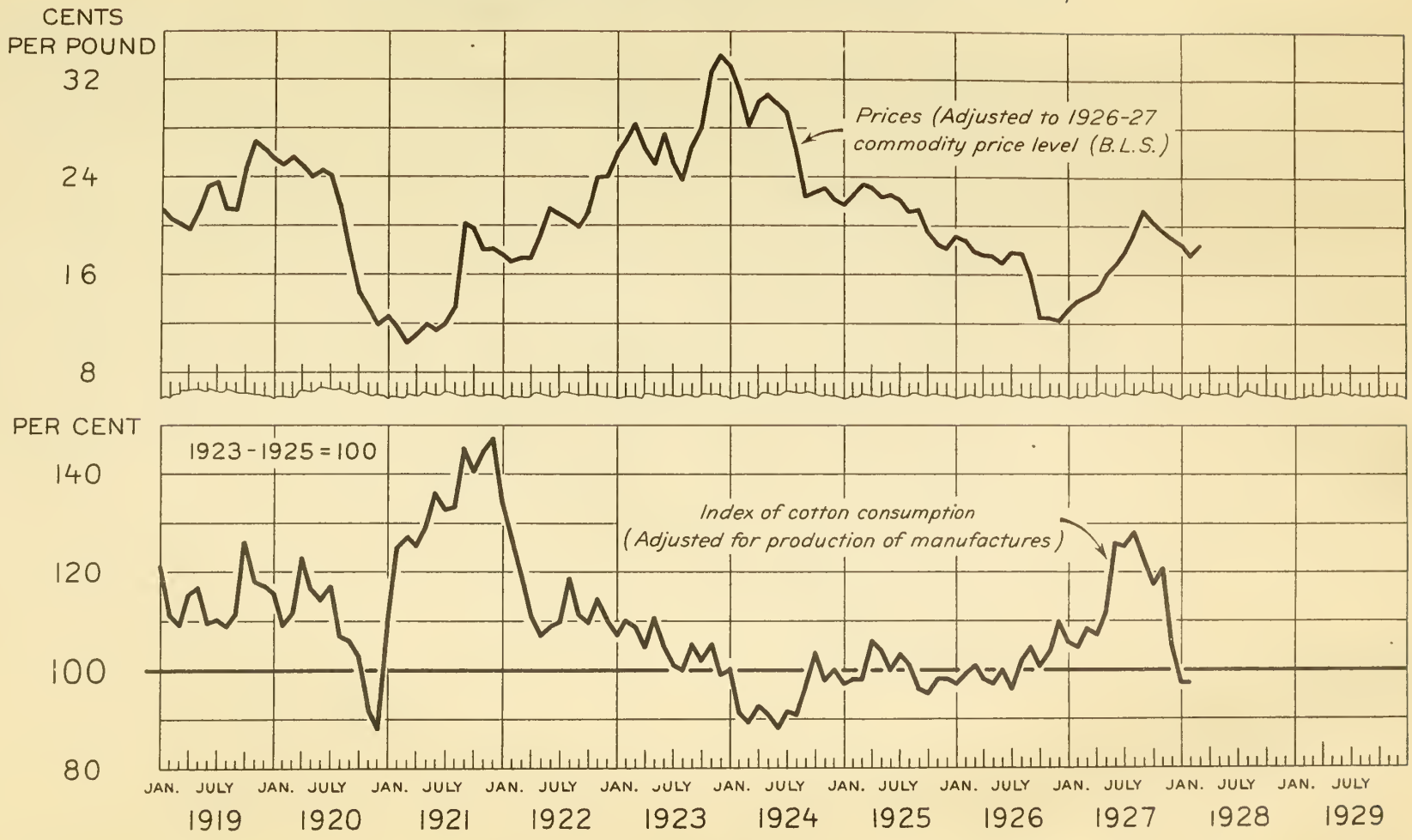
PRICES OF SPOT COTTON AT NEW ORLEANS
(ADJUSTED FOR CHANGES IN COMMODITY PRICES)

INDEX OF COTTON MILL CONSUMPTION
(ADJUSTED FOR CHANGES IN PRODUCTION OF MANUFACTURES)


CENTS PER POUND
32
24
16
8
Prices (Adjusted to 1926-27 commodity price level (B.L.S.)
PER CENT
1923-1925=100
140
120
100
80
Index of cotton consumption (Adjusted for production of manufactures)
JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY JAN. JULY
1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929

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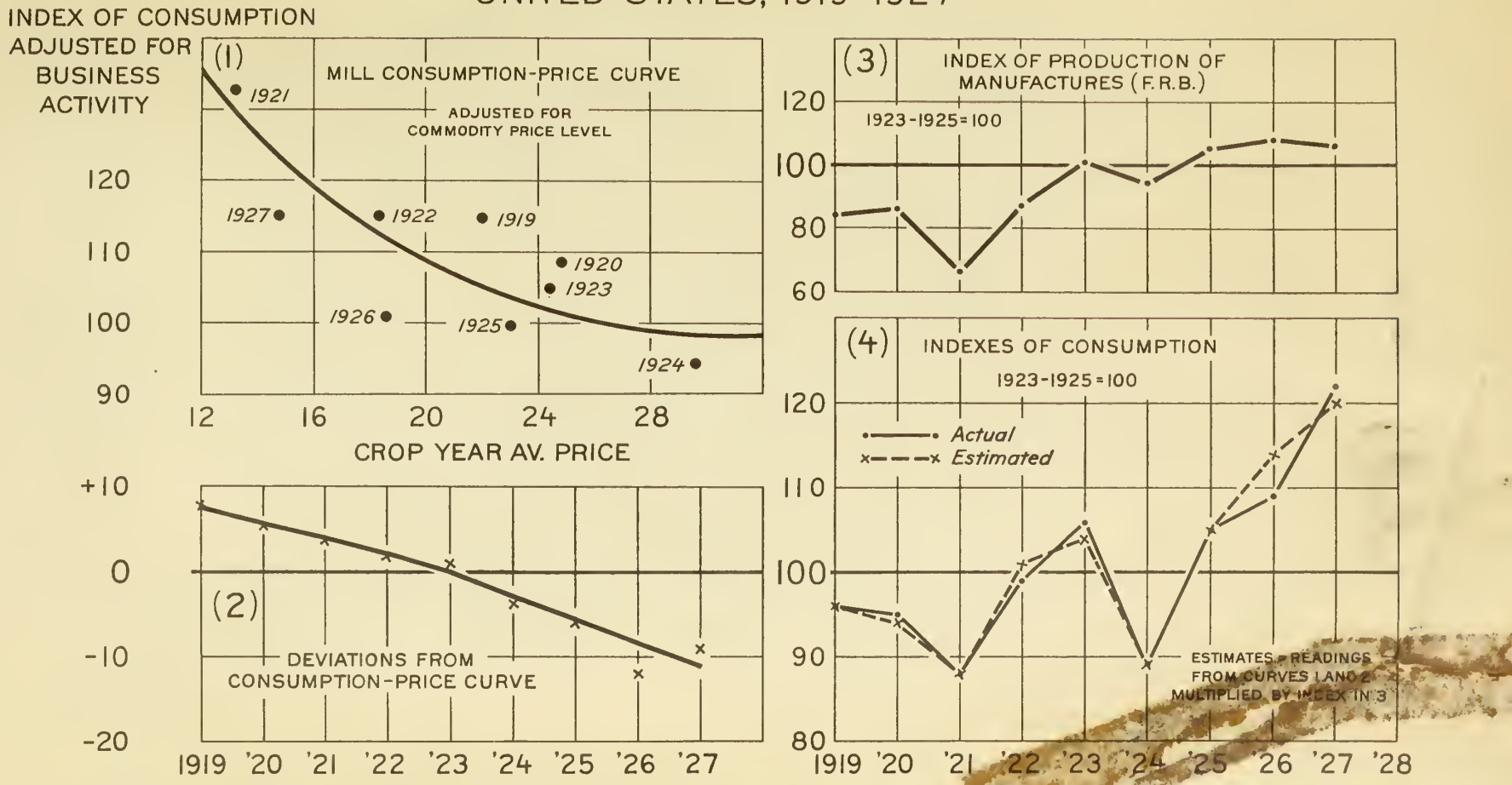
FACTORS AFFECTING MILL CONSUMPTION OF COTTON
UNITED STATES, 1919-1927



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